

PATENT COOPERATION T R A T Y

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year) 07 March 2001 (07.03.01)	
International application No. PCT/IB00/00706	Applicant's or agent's file reference 101672/PRS
International filing date (day/month/year) 08 May 2000 (08.05.00)	Priority date (day/month/year) 10 May 1999 (10.05.99)
Applicant BERGENWALL, Martin et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 05 December 2000 (05.12.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Zakaria EL KHODARY Telephone No.: (41-22) 338.83.38
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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For Receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum)

101672/PKS

Box No. I TITLE OF INVENTION

HEADER COMPRESSION

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

NOKIA NETWORKS OY
Kellalahdentie 4
FIN-02510 Espoo
Finland

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (that is, country) of nationality:

Finland (FI)

State (that is, country) of residence:

Finland (FI)

This person is applicant for the purposes of:

☐ all designated States

☒ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

BERGENWALL; Martin
Nokia Networks Oy
Kellalahdentie 4
FIN-02510 Espoo
Finland

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:

Finland (FI)

State (that is, country) of residence:

Finland (FI)

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☒ the United States of America only

☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent

☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

SLINGSBY; Philip Roy
Page White & Farrer
54 Poughtry Street
London WC1N 2LG
United Kingdom

Telephone No.

020 7831 7929

Facsimile No.

020 7831 8040

Teleprinter No.

8955681

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
<i>If none of the following sub-boxes is used, this sheet should not be included in the request.</i>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p> <p>FLYKT; Patrik Nokia Networks Oy Keilalahdentie 4 FIN-02510 Espoo Finland</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality: Finland (FI)	State (that is, country) of residence: Finland (FI)
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality:	State (that is, country) of residence:
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality:	State (that is, country) of residence:
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)</p>
State (that is, country) of nationality:	State (that is, country) of residence:
<p>This person is applicant for the purposes of:</p> <p><input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p><input type="checkbox"/> Further applicants and/or (further) inventors are indicated on another continuation sheet.</p>	

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 1.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CC Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates | <input checked="" type="checkbox"/> LR Liberia |
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MA Morocco |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BR Barbados | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CR Costa Rica | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> DM Dominica | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GN Grenada | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> GR Croatia | <input checked="" type="checkbox"/> TZ United Republic of Tanzania |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> IN India | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> IS Iceland | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> JP Japan | <input checked="" type="checkbox"/> YU Yugoslavia |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> ZA South Africa |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | |
| <input checked="" type="checkbox"/> LK Sri Lanka | |

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:
☒ People's Democratic Republic of Algeria
☒ Antigua and Barbuda

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

Sheet No. ...4...

Supplemental Box*Supplemental Box is not used, this sheet should not be included in the request.*

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." (indicate the number of the Box) and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

- (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;
- (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;
- (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;
- (iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;
- (v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;
- (vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;
- (vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed.

2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.

Continuation of Box No. IV
Agents continued

PALMER, Roger (GB)
 RICHARDS, David John (GB)
 JENKINS, Peter David (GB)
 DRIVER, Virginia Rozanne (GB)
 DANIELS, Jeffrey Nicholas (GB)
 STYLE, Kelda Camilla Karen (GB)
 HOBARD, William John (GB)
 AWACKLETON, Nicola (GB)
 HILL, Christopher Michael (GB)
 ROUSKANEN, Jyha-Pekka (FI)

all of: Page White & Farrer
 54 Doughty Street
 London WC1N 2TA
 United Kingdom

Tel: 020 7831 7929

Fax: 020 7831 8040

Telex: 8055601

Sheet No. 5

Box No. VI PRIORITY AIM		<input type="checkbox"/> Further priorities are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 10 May 1999 (10.05.99)	9910797.1	GB		
item (2) 18 May 1999 (18.05.99)	9911550.3	GB		
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII **INTERNATIONAL SEARCHING AUTHORITY**

Choice of International Searching Authority (ISA)
(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA/ EP

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

18 August 1999

RS 103005

GB

Box No. VIII **CHECK LIST; LANGUAGE OF FILING**

This international application contains the following number of sheets:

request : 5
description (excluding sequence listing part) : 12
claims : 3
abstract : 1
drawings : 2
sequence listing part of description :
Total number of sheets : 23

This international application is accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney; reference number, if any: GPA 00/0066
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other (specify):

Figure of the drawings which should accompany the abstract:

3

Language of filing of the international application:

English

Box No. IX **SIGNATURE OF APPLICANT OR AGENT**

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

SLINGSBY; Philip Roy - Authorised Representative

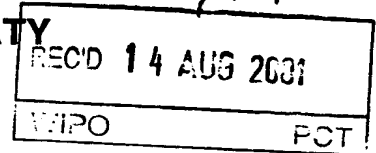
For receiving Office use only		3. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
1. Date of actual receipt of the purported international application:		
2. Corrected date of actual receipt due to later but duly received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority (if two or more are competent): ISA/	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

Date of receipt of the record copy by the International Bureau:

For International Bureau use only

PATENT COOPERATION TREATY

PCT



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 101672/PRS	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB00/00706	International filing date (<i>day/month/year</i>) 08/05/2000	Priority date (<i>day/month/year</i>) 10/05/1999
International Patent Classification (IPC) or national classification and IPC H04L29/06		
Applicant NOKIA NETWORKS OY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:

- | | |
|------|---|
| I | <input checked="" type="checkbox"/> Basis of the report |
| II | <input type="checkbox"/> Priority |
| III | <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| IV | <input type="checkbox"/> Lack of unity of invention |
| V | <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| VI | <input type="checkbox"/> Certain documents cited |
| VII | <input checked="" type="checkbox"/> Certain defects in the international application |
| VIII | <input type="checkbox"/> Certain observations on the international application |

Date of submission of the demand 05/12/2000	Date of completion of this report 10.08.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Hamer, J Telephone No. +49 89 2399 8827



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/00706

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1,4,7-12	as originally filed			
2,2a,3,5,6,6a	as received on	14/05/2001	with letter of	11/05/2001

Claims, No.:

1-15	as received on	14/05/2001	with letter of	11/05/2001
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Drawings, sheets:

1/2,2/2	as originally filed
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2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB00/00706

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-15
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

V- Reasoned Statement

1. The subject-matter of claim 1 is concerned with a method for communicating a message over a data path using a packet protocol. Control data in the packet header are used for error detection which in turn can be used to request a retransmission of the packet if necessary. If few errors occur, the loss of bandwidth which large headers bring can be compensated for by using header compression which is based on the fact that many of the fields in the headers change very little from one to another. However, on a link with a high bit error rate, e.g. a cellular radio link, the bandwidth used to retransmit packets which are wrongly received can be greater than the bandwidth saved by compressing the headers in the first place. None of the available prior art documents deals with this problem. EP-A-0 616 455 is concerned with the segmenting of messages; the size of the segments depends on the quality of the link. WO 96 21984 A is generally concerned with header compression by transmitting only changes to the headers (see section 2 starting on page 376). The document DEGERMARK M ET AL: 'LOW-LOSS TCP/IP HEADER COMPRESSION FOR WIRELESS NETWORKS' WIRELESS NETWORKS, vol. 3, no. 5, 1 October 1997 (1997-10-01), pages 375-387, XP000728935 ISSN: 1022- 0038 is concerned with packet compression in a special radio link protocol.

In claim 1, a different approach is taken. In this method, the quality of the data path is measured and then, depending on this measurement, a data segment format is chosen. The available formats differ in the amount of control data present, i.e. in the compression of the header. The advantage of this is the header compression can be varied to take account of the transmission path quality, thus ensuring a better overall transmission rate.

These features are found nowhere in the available prior art documents. As a result, the subject-matter of claim 1 involves an inventive step and claim 1 meets the requirements of Article 33(2) and (3) PCT.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB00/00706

2. The subject-matter of independent claim 15 is essentially the same as that of claim 1, but expressed in terms of apparatus features of a communications system. Thus for the same reasons outlined above, claim 15 also meets the requirements of Articles 33(2) and (3) PCT.
2. The subject-matter of dependent claims 2 to 14 includes features which further restricts the scope of claim 1. As a result, these claims also meet the requirements of Articles 33(2) and (3) PCT.

VII- Certain Defects

The following deficiency is found in the application:

The claims do not meet the requirements of Rule 6.2(b) PCT in that they do not contain reference signs.

The basic 40 byte header represents a significant proportion of the bandwidth used for the transmission. To address this high overhead a mechanism [RFCs 1144, 2507, 2508, 2509] for compression of TCP/IP headers has been developed. Using this mechanism the TCP/IP header can be compressed from 40 to a minimum of 4 bytes. TCP/IP header compression [RFC1144] is today widely used in combination with PPP (point-to-point protocol) for dial-up links over modem and other low speed connections.

The header compression mechanism is based on the fact that most of the fields in the TCP and IP headers are constant or change very little during the transmission of a message. For example, the source address and destination address are the same for all the packets of the message. To exploit this the header compression mechanism operates by transmitting the whole header only once, in the first packet of the message, and after that only the parts that have changed. The compression mechanism can be enhanced by not transmitting changes in the header that are obvious for both transmitter and receiver. Similar mechanisms have been proposed for UDP/IP and RTP/UDP/IP.

EP 0 616 455 describes a computer network where messages are sent over the links between the computers in compressed, segmented form, the size of the segments being appropriate to the transmission characteristics of the link.

WO 96/21984 describes a packet radio system which encapsulates data packets of external packet data networks by PPP and passes them through one or more sub-networks to a point which supports the protocol of the encapsulated data packet. A PPP packet is compressed before the encapsulation of a special radio link protocol by removing therefrom the unnecessary control fields.

The TCP/IP header compression mechanism is an effective way to improve bandwidth efficiency for many point to point links, when the link is reliable and there are no errors. However, if the compressed headers are distorted due to errors in the transmission link then significant problems can arise. Because the

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compression mechanism operates by transmitting only the changes from one header to the next, if one header is received wrongly then that error propagates and affects the receiver's interpretation of succeeding compressed headers, destroying the integrity of those headers' packets. This means that those packets must to be re-transmitted. On a link in which there is a high BER (bit error rate), such as many cellular radio links, the bandwidth used to retransmit packets that have been wrongly received due to header compression can be greater than the bandwidth saved by sending the compressed headers.

There is provision for a gradual increase in the level of TCP/IP header compression on a link over time. Full headers are sent periodically, and the interval between the sending of a full header increases exponentially to an upper limit. (The upper limit exists so that the connection will eventually overcome even an undetected bit error in a compressed header). If an error is detected, using the received data at the TCP/IP protocol level, then the interval is reset to the minimum and then begins to increase again.

Some high BER links run an error-checking retransmission protocol under the TCP/IP protocol to ensure that the TCP/IP protocol receives data intact and free from bit errors. However, the presence of an underlying retransmission protocol cannot be guaranteed – for example, in the proposed standard for the transmission of packet data over third-generation (UMTS) cellular systems the use of a layer 2 retransmission protocol is still uncertain.

There is therefore a need for an improved method of header compression.

According to one aspect of the present invention there is provided a method for communicating a message over a data path, the method comprising: forming a plurality of individual data segments together representing the message, each data segment having control data; transferring the data segments over the data path; characterised in that the quality of the data path is estimated such that the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path and wherein the available segment formats differ in the amount of control data that they include.

Preferably the amount of control data is for example error check and/or correction data and/or data for other control purposes as set out above. There may be two or more available segment

The quality of the data path or a representative path may be estimated by any suitable measure, or by more than one measure. The quality of the data path or a representative path may be estimated by means of one or more of the following measures: signal to interference ratio, bit error rate, power loss over the path, required transmission power over the path, delay over the path. The quality of the data path may be estimated periodically. The quality of the data path is preferably estimated periodically so as to update the estimate of quality one or more times during the step of forming the plurality of individual data segments together representing the message

The path may include a portion over which no bit error correction protocol is applied, e.g. a radio link over which there is no layer 2 protocol. The path may include a portion constituted by a radio link, e.g. a satellite or cellular telephony link.

The data segments may be formed and/or transferred according to one or more of the following protocols: TCP, IP, UDP, RTP.

Each packet preferably includes message data representing at least part of the message. Each of the available segment formats may have the same capacity to carry message data.

The control data of each segment may include first control data (e.g. header data) for permitting detection and/or correction of errors in message data of the segment and/or for permitting control over the transmission and/or reception of the segment and second control data (e.g. header error check data) for permitting detection and/or correction of errors in the first control data. Preferably any available segment formats including greater amounts of first control data include greater amounts of second control data.

According to a second aspect of the present invention there is provided a communication system for communicating a message over a data path,

comprising: data forming apparatus for forming a plurality of individual data segments together representing the message, each data segment having control data; data transfer apparatus capable of transmitting the data segments over the data path; characterised in having: path quality estimation apparatus for estimating the quality of the path and in the data forming apparatus the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path wherein the available segment formats differ in the amount of control data that they include.

The present invention will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic diagram of a telecommunications system;

Figure 2 shows a simplified protocol stack for transmission of data in the system of figure 1; and

Figure 3 shows the structure of data packets.

The telecommunications system of figure 1 comprises a cellular telephone system that is controlled by control apparatus indicated as 1. The control apparatus controls radio base stations 2, 3 which are capable of communicating with handset terminals 4, 5 by radio. The control apparatus is linked to a public service telephone network (PSTN) 6 and to packet-based networks 7 such as the internet. Terminals 8, 9 are linked directly to the networks 6, 7 respectively. Users of any of the terminals may communicate with the users of any of the other terminals by establishing a connection across the intervening equipment.

Figure 2 shows a simplified protocol stack for a data connection between terminal 4 and terminal 9 via base station 2. The data connection illustrated by figure 2 is the transmission of a message of data stored at the terminal 4 – for example a text message or data representing a photograph. To support this connection the TCP/IP protocol is run between the terminal 4 and the terminal 9; and below the TCP/IP protocol a layer 1 protocol is run between the terminal 4 and the base station 2. Accordingly, figure 1 shows that the terminal 4 includes TCP/IP

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processing apparatus 20 and layer 1 processing apparatus 21, the base station 2

CLAIMS

1. A method for communicating a message over a data path, the method comprising:

forming a plurality of individual data segments together representing the message, each data segment having control data;

transferring the data segments over the data path;

characterised in that the quality of the data path is estimated and the format of each data segment is selected from one of a plurality of available segment formats in dependence on the quality of the data path and wherein the available segment formats differ in the amount of control data that they include.

2. A method as claimed in claim 1, wherein the method comprises selecting one or more segment formats that include a greater amount of control data increasingly when the indicated quality decreases.

3. A method as claimed in claim 1 or 2, wherein the available segment formats include a first format including a first amount of control data and a second format including a second amount of control data, the second amount being less than the first amount, and wherein the method comprises selecting the first format with increasing frequency when the indicated quality of the link decreases.

4. A method as claimed in any of claims 1 to 3, wherein the data segments are packets.

5. A method as claimed in claim 4, wherein the control data is comprised in a header and/or trailer of each packet.

6. A method as claimed in claim 5 as dependent on claim 3, wherein the first format is a format having a non-compressed header and the second format is a format having a compressed header.

7. A method as claimed in any preceding claim, wherein the quality of the data path is estimated by means of one or more of the following measures: signal to interference ratio, bit error rate, power loss over the path, required transmission power over the path, delay over the path.
8. A method as claimed in any preceding claim, wherein the path includes a portion over which no bit error correction protocol is applied.
9. A method as claimed in any preceding claim, wherein the path includes a portion constituted by a radio link.
10. A method as claimed in any preceding claim, wherein the data segments are formed and transferred according to one or more of the following protocols: TCP, IP, UDP, RTP.
11. A method as claimed in any of claims 1 to 10, wherein each packet includes message data representing at least part of the message.
12. A method as claimed in claim 11, wherein the available segment formats do not differ in their ability to comprise message data.
13. A method as claimed in claim 11 or 12, wherein the control data of each segment includes first control data for permitting control of the transmission and/or reception of the segment and second control data for permitting detection and/or correction of errors in the first control data.
14. A method as claimed in claim 13, wherein the available segment formats including greater amounts of first control data include greater amounts of second control data.
15. A communication system for communicating a message over a data path, comprising:

data forming apparatus for forming a plurality of individual data segments together representing the message, each data segment having control data;

data transfer apparatus capable of transmitting the data segments over the data path;

characterised in having:

path quality estimation apparatus for estimating the quality of the path and in the data forming apparatus the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path wherein the available segment formats differ in the amount of control data that they include.



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UNITED KINGDOM

RECEIVED
19 AUG 1999
Ans'd

Aktenzeichen/File No./No. du Dossier

RS 103005 GB

Datum/Date

18.08.99

Das Europäische Patentamt übermittelt hiermit den Standardrecherchenbericht zu dem unten bezeichneten Antrag; Kopien der im Recherchenbericht angeführten Schriften werden in der Anlage beigelegt.

The European Patent Office herewith transmits the Standard Search Report relating to the request indicated below; copies of the documents cited in the search report are enclosed.

L'Office Européen des Brevets à l'honneur de vous transmettre ci-joint le Rapport de Recherche concernant la demande désignée ci-dessous; des copies des documents cités sont jointes.

Zeichen und Datum des Antrages Applicant's reference and date Références et date de la demande	89915/PRS
Dokument, Gegenstand der Recherche Document subject of the search Objet de la recherche	GBA 9910797
Einreichungstag Filing date Date de dépôt	10/05/1999
Beanspruchte Priorität Priority claimed Priorité revendiquée	

OFFICE EUROPÉEN DES BREVETS
Pour le Vice-Président,

R. de Best



European Patent
Office

STANDARD SEARCH REPORT

File
RS 103005

DOCUMENTS CONSIDERED TO BE RELEVANT																		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim																
X Y A	EP 0 616 455 A (IBM) 21 September 1994 (1994-09-21) * abstract * * column 2, line 9-25 * * column 3, line 11-38 * * column 4, line 18-50 * * column 7, line 56 - column 8, line 4 * * column 8, line 23-34 * * column 2, line 52-56 * * column 3, line 18-38 * ---	1,8, 17-20 2-7,9, 11-15 16																
Y	DEGERMARK M ET AL: "LOW-LOSS TCP/IP HEADER COMPRESSION FOR WIRELESS NETWORKS" WIRELESS NETWORKS, vol. 3, no. 5, 1 October 1997 (1997-10-01), pages 375-387, XP000728935 ISSN: 1022-0038 * page 377, right-hand column, line 6 - page 378, left-hand column, line 2 * * page 378, left-hand column, line 22 - right-hand column, line 11 * * page 379, left-hand column, line 1-23 * * page 380, left-hand column, line 30 - page 381, left-hand column, line 22 * ---	2-7,9, 11-15																
A	WO 96 21984 A (NOKIA TELECOMMUNICATIONS OY ;KARI HANNU H (FI); KARPPANEN ARTO (FI) 18 July 1996 (1996-07-18) * abstract * * page 3, line 5 - page 4, line 4 * * page 5, line 5 - page 7, line 18 * * page 12, line 18-28 * * page 14, line 12 - page 15, line 25 * * page 17, line 17-22 * -----	1-20																
The present search report has been drawn up for all claims																		
Date of completion of the search 11 August 1999		Examiner Lázaro López, M.L.																
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS</td><td>T : theory or principle underlying the invention</td></tr><tr><td>X : particularly relevant if taken alone</td><td>E : earlier patent document, but published on, or</td></tr><tr><td>Y : particularly relevant if combined with another</td><td>after the filing date</td></tr><tr><td>document of the same category</td><td>D : document cited in the application</td></tr><tr><td>A : technological background</td><td>L : document cited for other reasons</td></tr><tr><td>O : non-written disclosure</td><td></td></tr><tr><td>P : intermediate document</td><td>& : member of the same patent family, corresponding</td></tr><tr><td></td><td>document</td></tr></table>			CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention	X : particularly relevant if taken alone	E : earlier patent document, but published on, or	Y : particularly relevant if combined with another	after the filing date	document of the same category	D : document cited in the application	A : technological background	L : document cited for other reasons	O : non-written disclosure		P : intermediate document	& : member of the same patent family, corresponding		document
CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention																	
X : particularly relevant if taken alone	E : earlier patent document, but published on, or																	
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document of the same category	D : document cited in the application																	
A : technological background	L : document cited for other reasons																	
O : non-written disclosure																		
P : intermediate document	& : member of the same patent family, corresponding																	
	document																	

ANNEX TO THE STANDARD SEARCH REPORT NO.

RS 103005

This annex lists the patent family members relating to the patent documents cited in the above-mentioned search report.
The members are as contained in the European Patent Office EDP file on
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11-08-1999

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		CA 2099421 A,C	20-03-1994
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		JP 6223011 A	12-08-1994
		JP 8027767 B	21-03-1996
		US 5870563 A	09-02-1999
WO 9621984 A	18-07-1996	FI 950117 A	11-07-1996
		AU 699246 B	26-11-1998
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		CA 2209944 A	18-07-1996
		EP 0804845 A	05-11-1997
		JP 10512120 T	17-11-1998
		NO 973176 A	09-09-1997

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 101672/PRS	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/IB 00/ 00706	International filing date (day/month/year) 08/05/2000	(Earliest) Priority Date (day/month/year) 10/05/1999
Applicant NOKIA NETWORKS OY et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

3



None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/00706

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	<p>EP 0 616 455 A (IBM) 21 September 1994 (1994-09-21)</p> <p>abstract column 2, line 9-25 column 3, line 11-38 column 4, line 18-50 column 7, line 56 -column 8, line 4 column 8, line 23-34 column 2, line 52-56 column 3, line 18-38</p> <p>--- -/--</p>	<p>1,8, 17-20 2-7,9, 11-15 16</p>

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

8 November 2000

Date of mailing of the international search report

15/11/2000

Name and mailing address of the ISA

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Authorized officer

Lázaro López, M.L.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 00/00706

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DEGERMARK M ET AL: "LOW-LOSS TCP/IP HEADER COMPRESSION FOR WIRELESS NETWORKS" WIRELESS NETWORKS, vol. 3, no. 5, 1 October 1997 (1997-10-01), pages 375-387, XP000728935 ISSN: 1022-0038 page 377, right-hand column, line 6 -page 378, left-hand column, line 2 page 378, left-hand column, line 22 -right-hand column, line 11 page 379, left-hand column, line 1-23 page 380, left-hand column, line 30 -page 381, left-hand column, line 22 -----	2-7, 9, 11-15
A	WO 96 21984 A (NOKIA TELECOMMUNICATIONS OY ;KARI HANNU H (FI); KARPPANEN ARTO (FI) 18 July 1996 (1996-07-18) abstract page 3, line 5 -page 4, line 4 page 5, line 5 -page 7, line 18 page 12, line 18-28 page 14, line 12 -page 15, line 25 page 17, line 17-22 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 00/00706

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EP 0616455	A	21-09-1994	GB 2270821 A	23-03-1994
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			JP 10512120 T	17-11-1998
			NO 973176 A	09-09-1997
			US 5978386 A	02-11-1999
<hr/>				



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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H04L 29/00

A2

(11) International Publication Number:

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(30) Priority Data:

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(71) Applicant (for all designated States except US): NOKIA NETWORKS OY [FI/FI]; Keilalahdentie 4, FIN-02510 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): BERGENWALL, Martin [FI/FI]; Nokia Networks Oy, Keilalahdentie 4, FIN-02510 Espoo (FI). FLYKT, Patrick [FI/FI]; Nokia Networks Oy, Keilalahdentie 4, FIN-02510 Espoo (FI).

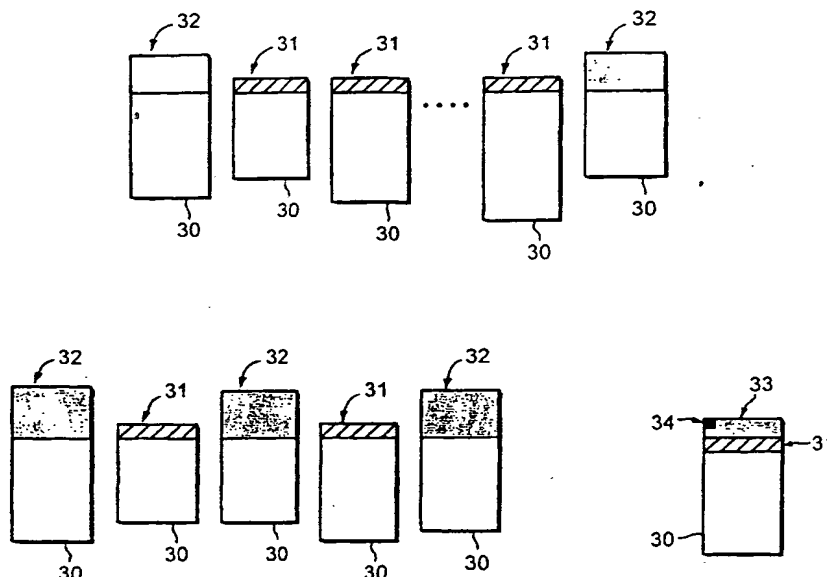
(74) Agents: SLINGSBY, Philip, Roy et al.; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).

(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

Without international search report and to be republished upon receipt of that report.

(54) Title: HEADER COMPRESSION



(57) Abstract

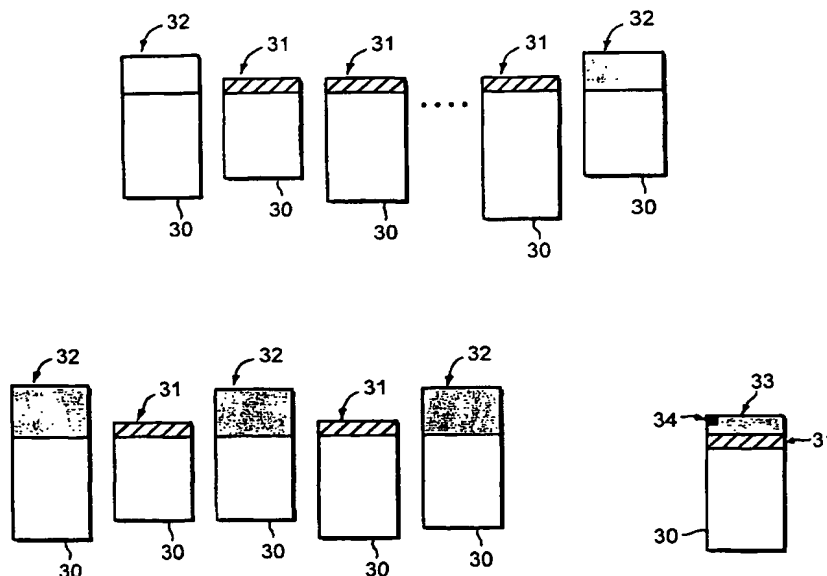
A method for communicating a message over a data path by means of data transfer apparatus capable of: transmitting the data over the data path; generating a representation of the data as received from the data path and generating an indication of the communication quality of the data path; the method comprising: forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path; transferring the segments over the data path by means of the data transfer apparatus; and combining the segments as received from the data transfer apparatus to form a representation of the message.

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : H04L 29/00		A2	(11) International Publication Number: WO 00/69139
			(43) International Publication Date: 16 November 2000 (16.11.00)

<p>(21) International Application Number: PCT/IB00/00706</p> <p>(22) International Filing Date: 8 May 2000 (08.05.00)</p> <p>(30) Priority Data: 9910797.1 10 May 1999 (10.05.99) GB 9911550.3 18 May 1999 (18.05.99) GB</p> <p>(71) Applicant (for all designated States except US): NOKIA NETWORKS OY [FI/FI]; Keilalahdentie 4, FIN-02510 Espoo (FI).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): BERGENWALL, Martin [FI/FI]; Nokia Networks Oy, Keilalahdentie 4, FIN-02510 Espoo (FI). FLYKT, Patrick [FI/FI]; Nokia Networks Oy, Keilalahdentie 4, FIN-02510 Espoo (FI).</p> <p>(74) Agents: SLINGSBY, Philip, Roy et al.; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).</p>	<p>(81) Designated States: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published Without international search report and to be republished upon receipt of that report.</p>
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(54) Title: HEADER COMPRESSION



(57) Abstract

A method for communicating a message over a data path by means of data transfer apparatus capable of: transmitting the data over the data path, generating a representation of the data as received from the data path and generating an indication of the communication quality of the data path; the method comprising: forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path; transferring the segments over the data path by means of the data transfer apparatus; and combining the segments as received from the data transfer apparatus to form a representation of the message.

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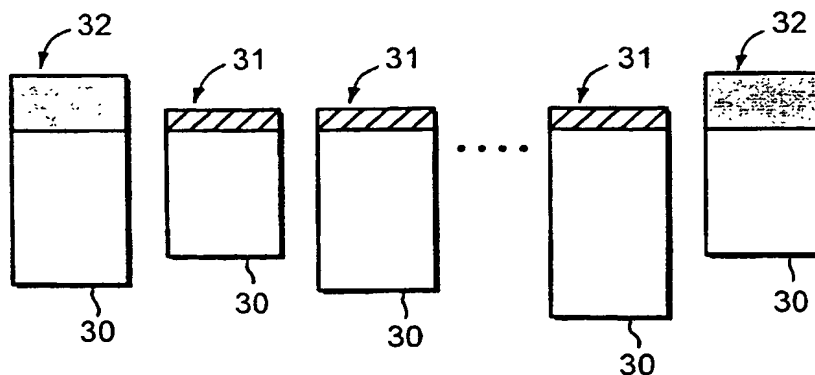
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data path; transferring the segments over the data path by means of the data transfer apparatus; and combining the segments as received from the data transfer apparatus to form a representation of the message.

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	<p>EP 0 616 455 A (IBM) 21 September 1994 (1994-09-21)</p> <p>abstract column 2, line 9-25 column 3, line 11-38 column 4, line 18-50 column 7, line 56 -column 8, line 4 column 8, line 23-34 column 2, line 52-56 column 3, line 18-38</p> <p style="text-align: center;">--- -/--</p>	<p>1,8, 17-20 2-7,9, 11-15 16</p>

☒ Further documents are listed in the continuation of box C.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>DEGERMARK M ET AL: "LOW-LOSS TCP/IP HEADER COMPRESSION FOR WIRELESS NETWORKS" WIRELESS NETWORKS, vol. 3, no. 5, 1 October 1997 (1997-10-01), pages 375-387, XP000728935 ISSN: 1022-0038 page 377, right-hand column, line 6 -page 378, left-hand column, line 2 page 378, left-hand column, line 22 -right-hand column, line 11 page 379, left-hand column, line 1-23 page 380, left-hand column, line 30 -page 381, left-hand column, line 22</p>	<p>2-7,9, 11-15</p>
A	<p>WO 96 21984 A (NOKIA TELECOMMUNICATIONS OY ;KARI HANNU H (FI); KARPPANEN ARTO (FI) 18 July 1996 (1996-07-18) → abstract page 3, line 5 -page 4, line 4 page 5, line 5 -page 7, line 18 page 12, line 18-28 page 14, line 12 -page 15, line 25 page 17, line 17-22</p>	<p>1-20</p>

INTERNATIONAL SEARCH REPORT

Information on patent family members

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The basic 40 byte header represents a significant proportion of the bandwidth used for the transmission. To address this high overhead a mechanism [RFCs 1144, 2507, 2508, 2509] for compression of TCP/IP headers has been developed. Using this mechanism the TCP/IP header can be compressed from 40 to a minimum of 4 bytes. TCP/IP header compression [RFC1144] is today widely used in combination with PPP (point-to-point protocol) for dial-up links over modem and other low speed connections.

The header compression mechanism is based on the fact that most of the fields in the TCP and IP headers are constant or change very little during the transmission of a message. For example, the source address and destination address are the same for all the packets of the message. To exploit this the header compression mechanism operates by transmitting the whole header only once, in the first packet of the message, and after that only the parts that have changed. The compression mechanism can be enhanced by not transmitting changes in the header that are obvious for both transmitter and receiver. Similar mechanisms have been proposed for UDP/IP and RTP/UDP/IP.

The TCP/IP header compression mechanism is an effective way to improve bandwidth efficiency for many point to point links, when the link is reliable and there are no errors. However, if the compressed headers are distorted due to errors in the transmission link then significant problems can arise. Because the compression mechanism operates by transmitting only the changes from one header to the next, if one header is received wrongly then that error propagates and affects the receiver's interpretation of succeeding compressed headers, destroying the integrity of those headers' packets. This means that those packets must to be re-transmitted. On a link in which there is a high BER (bit error rate), such as many cellular radio links, the bandwidth used to retransmit packets that have been wrongly received due to header compression can be greater than the bandwidth saved by sending the compressed headers.

There is provision for a gradual increase in the level of TCP/IP header compression on a link over time. Full headers are sent periodically, and the interval between the sending of a full header increases exponentially to an upper limit. (The upper limit exists so that the connection will eventually overcome even an undetected bit error in a compressed header). If an error is detected, using the received data at the TCP/IP protocol level, then the interval is reset to the minimum and then begins to increase again.

Some high BER links run an error-checking retransmission protocol under the TCP/IP protocol to ensure that the TCP/IP protocol receives data intact and free from bit errors. However, the presence of an underlying retransmission protocol cannot be guaranteed – for example, in the proposed standard for the transmission of packet data over third-generation (UMTS) cellular systems the use of a layer 2 retransmission protocol is still uncertain.

There is therefore a need for an improved method of header compression.

According to one aspect of the present invention there is provided a method for communicating a message over a data path by means of data transfer apparatus capable of: transmitting the data over the data path, generating a representation of the data as received from the data path and generating an indication of the communication quality of the data path; the method comprising: forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path; transferring the segments over the data path by means of the data transfer apparatus; and combining the segments as received from the data transfer apparatus to form a representation of the message.

Preferably the available segment formats differ in the amount of control data - e.g. error check and/or correction data and/or data for other control purposes as set out above - that they include. There may be two or more available segment

The quality of the data path or a representative path may be estimated by any suitable measure, or by more than one measure. The quality of the data path or a representative path may be estimated by means of one or more of the following measures: signal to interference ratio, bit error rate, power loss over the path, required transmission power over the path, delay over the path. The quality of the data path may be estimated periodically. The quality of the data path is preferably estimated periodically so as to update the estimate of quality one or more times during the step of forming the plurality of individual data segments together representing the message

The path may include a portion over which no bit error correction protocol is applied, e.g. a radio link over which there is no layer 2 protocol. The path may include a portion constituted by a radio link, e.g. a satellite or cellular telephony link.

The data segments may be formed and/or transferred according to one or more of the following protocols: TCP, IP, UDP, RTP.

Each packet preferably includes message data representing at least part of the message. Each of the available segment formats may have the same capacity to carry message data.

The control data of each segment may include first control data (e.g. header data) for permitting detection and/or correction of errors in message data of the segment and/or for permitting control over the transmission and/or reception of the segment and second control data (e.g. header error check data) for permitting detection and/or correction of errors in the first control data. Preferably any available segment formats including greater amounts of first control data include greater amounts of second control data.

According to a second aspect of the present invention there is provided a communication system for communicating a message over a data path,

comprising: path quality estimation apparatus for estimating the quality of the path; data forming apparatus for forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path; and data transfer apparatus capable of transmitting the data over the data path. Preferred features of such a system may be analogous to those set out above in relation to the first aspect of the invention.

The present invention will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic diagram of a telecommunications system;

Figure 2 shows a simplified protocol stack for transmission of data in the system of figure 1; and

Figure 3 shows the structure of data packets.

The telecommunications system of figure 1 comprises a cellular telephone system that is controlled by control apparatus indicated as 1. The control apparatus controls radio base stations 2, 3 which are capable of communicating with handset terminals 4, 5 by radio. The control apparatus is linked to a public service telephone network (PSTN) 6 and to packet-based networks 7 such as the internet. Terminals 8, 9 are linked directly to the networks 6, 7 respectively. Users of any of the terminals may communicate with the users of any of the other terminals by establishing a connection across the intervening equipment.

Figure 2 shows a simplified protocol stack for a data connection between terminal 4 and terminal 9 via base station 2. The data connection illustrated by figure 2 is the transmission of a message of data stored at the terminal 4 – for example a text message or data representing a photograph. To support this connection the TCP/IP protocol is run between the terminal 4 and the terminal 9; and below the TCP/IP protocol a layer 1 protocol is run between the terminal 4 and the base station 2. Accordingly, figure 1 shows that the terminal 4 includes TCP/IP processing apparatus 20 and layer 1 processing apparatus 21, the base station 2

CLAIMS

1. A method for communicating a message over a data path by means of data transfer apparatus capable of: transmitting the data over the data path, generating a representation of the data as received from the data path and generating an indication of the communication quality of the data path; the method comprising:

forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path;

transferring the segments over the data path by means of the data transfer apparatus; and

combining the segments as received from the data transfer apparatus to form a representation of the message.

2. A method as claimed in any preceding claim, wherein the available segment formats differ in the amount of control data that they include.

3. A method as claimed in claim 2, wherein the method comprises selecting one or more segment formats that include a greater amount of control data increasingly preferentially when the indicated quality decreases.

4. A method as claimed in claim 2 or 3, wherein the available segment formats include a first format including a first amount of control data and a second format including a second amount of control data, the second amount being less than the first amount, and wherein the method comprises selecting the first format with increasing frequency when the indicated quality of the link decreases.

5. A method as claimed in any of claims 2 to 4, wherein the data segments are packets.

6. A method as claimed in claim 6, wherein the control data is comprised in a header and/or trailer of each packet.

7. A method as claimed in claim 6 as dependent on claim 4, wherein the first format is a format having a non-compressed header and the second format is a format having a compressed header.
8. A method as claimed in any preceding claim, wherein the method comprises estimating the quality of the data path.
9. A method as claimed in any preceding claim, wherein the quality of the data path is estimated by means of one or more of the following measures: signal to interference ratio, bit error rate, power loss over the path, required transmission power over the path, delay over the path.
10. A method as claimed in any preceding claim, wherein the path includes a portion over which no bit error correction protocol is applied.
11. A method as claimed in any preceding claim, wherein the path includes a portion constituted by a radio link.
12. A method as claimed in any preceding claim, wherein the data segments are formed and transferred according to one or more of the following protocols: TCP, IP, UDP, RTP.
13. A method as claimed in any of claims 2 to 12 as dependant directly or indirectly on claim 2, wherein each packet includes message data representing at least part of the message.
14. A method as claimed in claim 13, wherein the available segment formats do not differ in their ability to comprise message data.
15. A method as claimed in claim 13 or 14, wherein the control data of each segment includes first control data for permitting control of the transmission and/or

reception of the segment and second control data for permitting detection and/or correction of errors in the first control data.

16. A method as claimed in claim 15, wherein the available segment formats including greater amounts of first control data include greater amounts of second control data.

17. A communication system for communicating a message over a data path, comprising:

path quality estimation apparatus for estimating the quality of the path;

data forming apparatus for forming a plurality of individual data segments together representing the message, the format of each data segment being selected from one of a plurality of available segment formats in dependence on the quality of the data path; and

data transfer apparatus capable of transmitting the data over the data path.